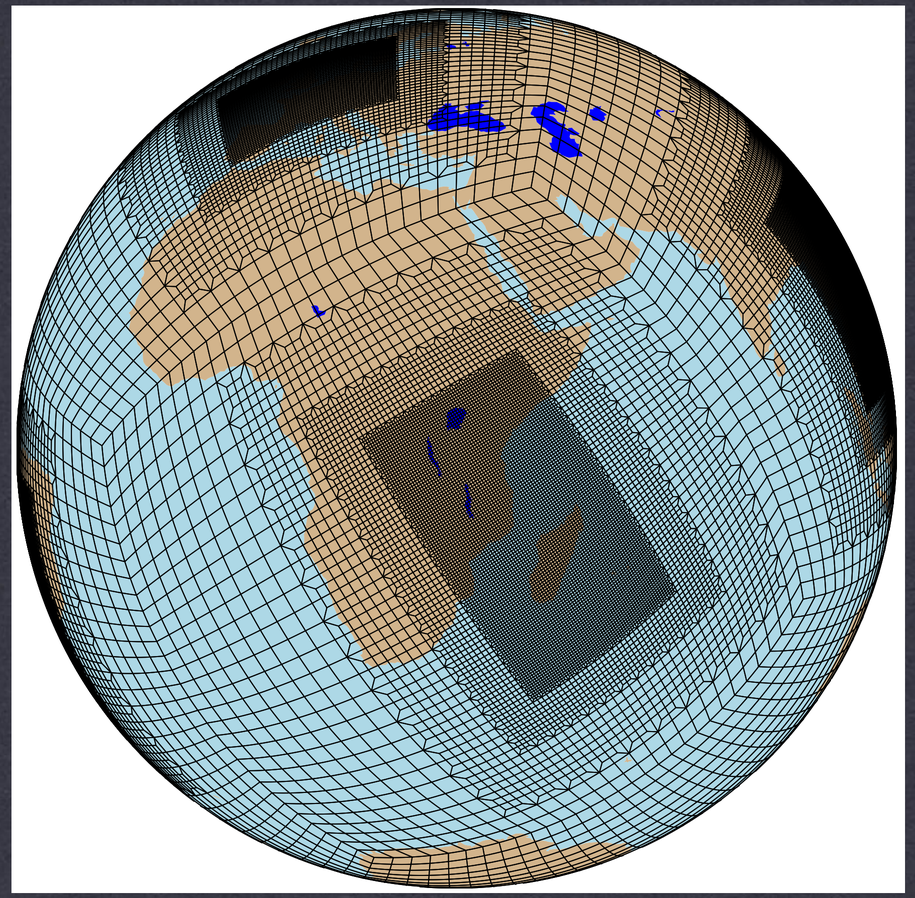

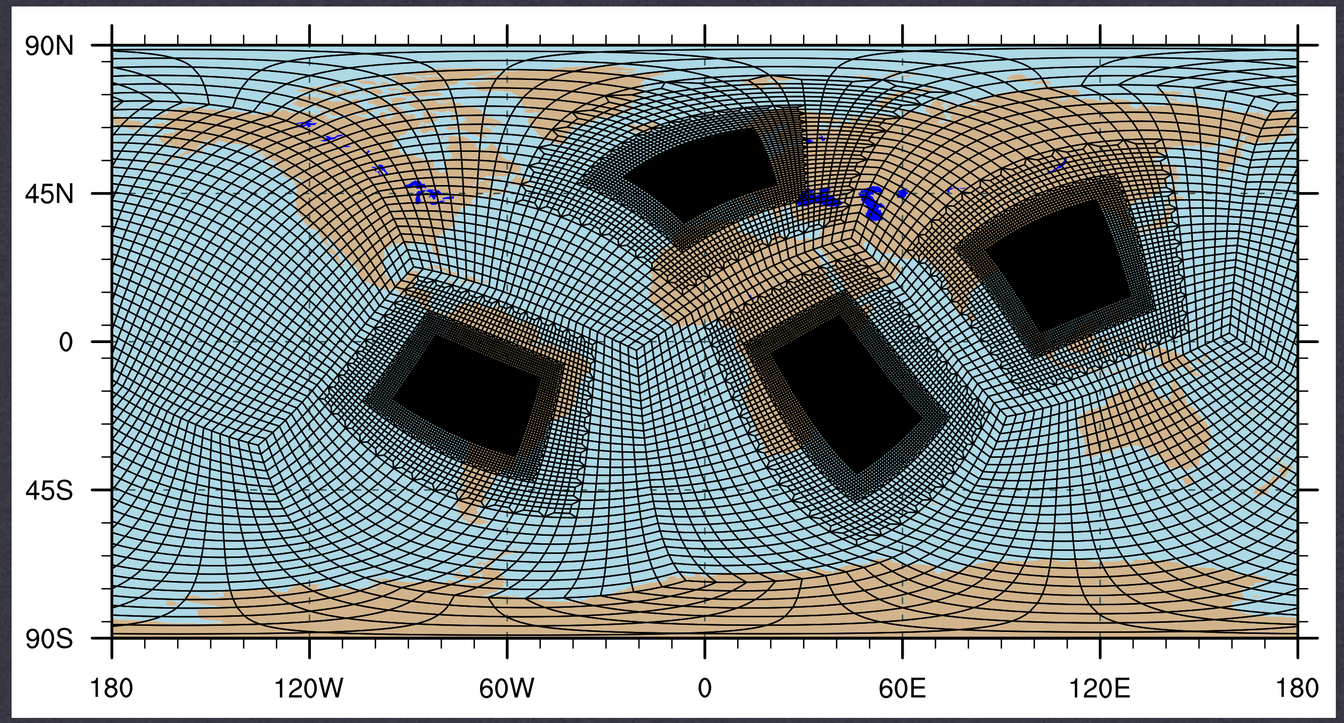

PROGRESS ON VR-CESM

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WYSS ACADEMY FOR NATURE
15.05.2024

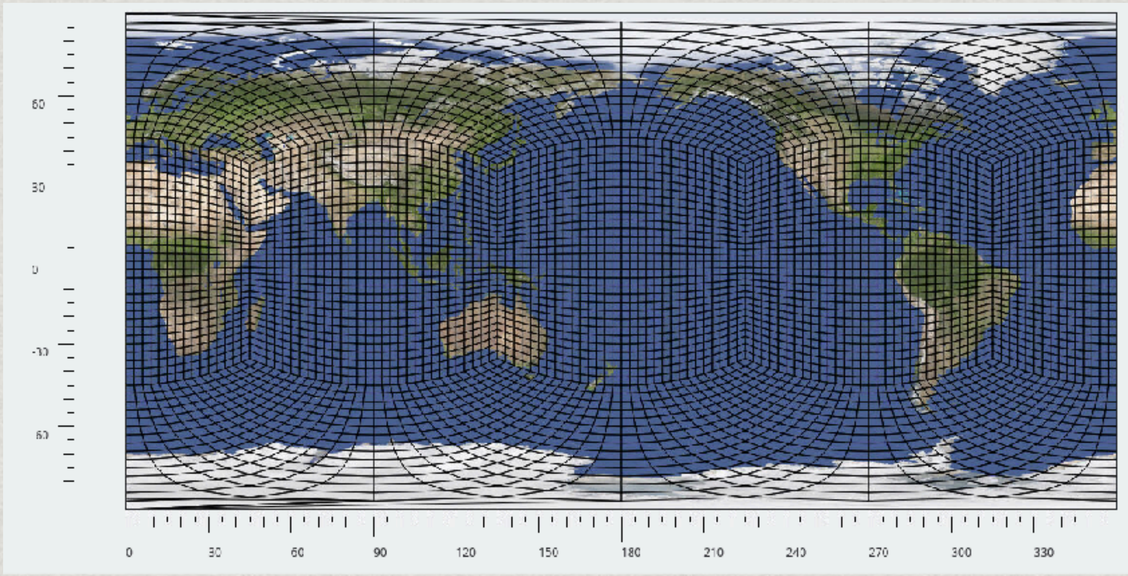
Phase 1: Initial Generation of a Grid

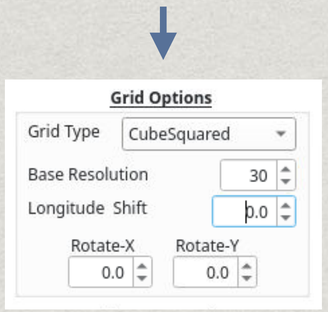
- Need to have:
  - Community Mesh Generation Tools
  - TigerVNC Viewer
  - NCL

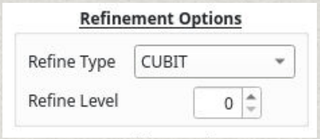
Initial Generation of a Grid

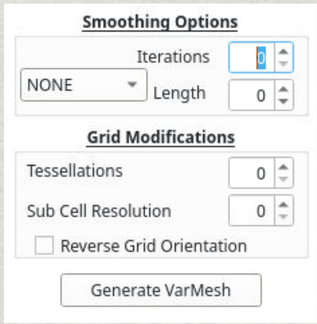
- VRM Editor (Community Tools)
- Connect to server through TigerVNC

Default Grid









Initial Generation of a Grid

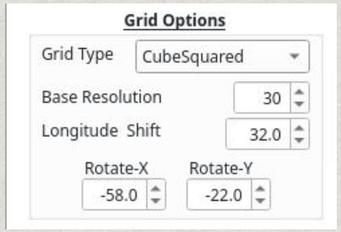
- Making one zoomed in grid is relatively simple.
  - Guess, check, and rotate.
- However, when adding multiple locations, the system is too slow to guess and check.
  - Solution: the development of a Mathematica code for solving a ‘lowest energy state’ problem (w/ Prof. Jan Draisma).
- Perhaps convert the code to python?

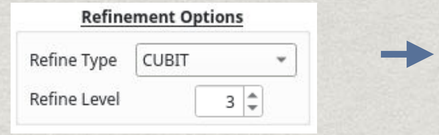
Example Mathematica Notebook

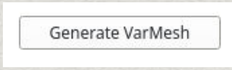
```
Cell["\<\
Running this many times, we get many different answers. It would make sense \
to mod out the symmetries of the cube. Perhaps we then find only a few \
answers. I haven\[CloseCurlyQuote]t tried to implement this. Also one needs \
to have a closer look at the precise ranges of x,y,z---what I did above seems \
reasonable and parameterises all rotations, but seems not to agree with the \
settings of the software.\
\>", "Text",
 CellChangeTimes->{{3.921292285843473*^9,
  3.921292367282873*^9}},ExpressionUUID->"be85f8ba-7fc3-452d-b540-\
5330af5f08e9"]
},
```

Initial Generation of a Grid

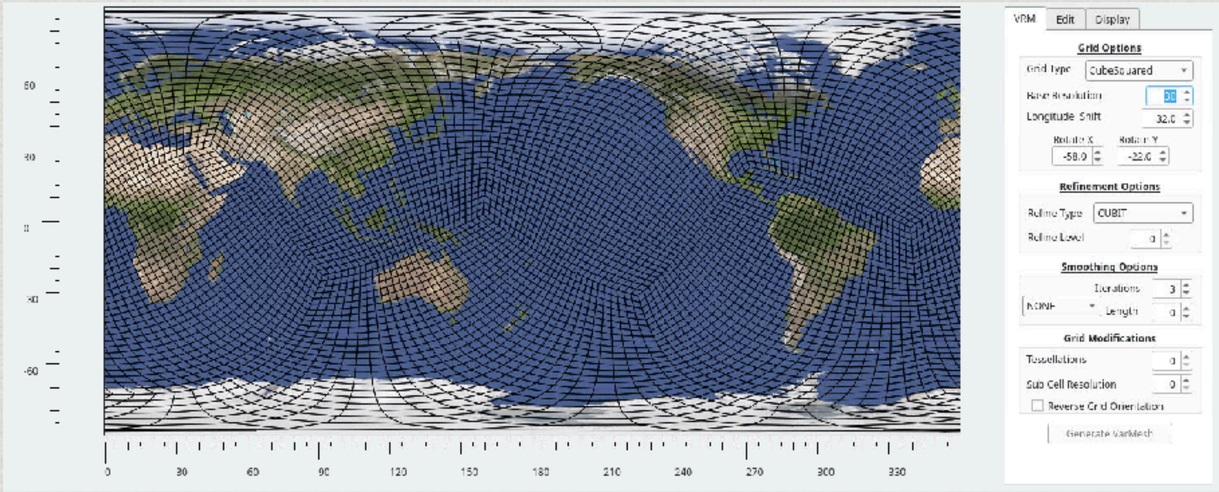
- With the coordinate solutions, enter them into VRM Editor.





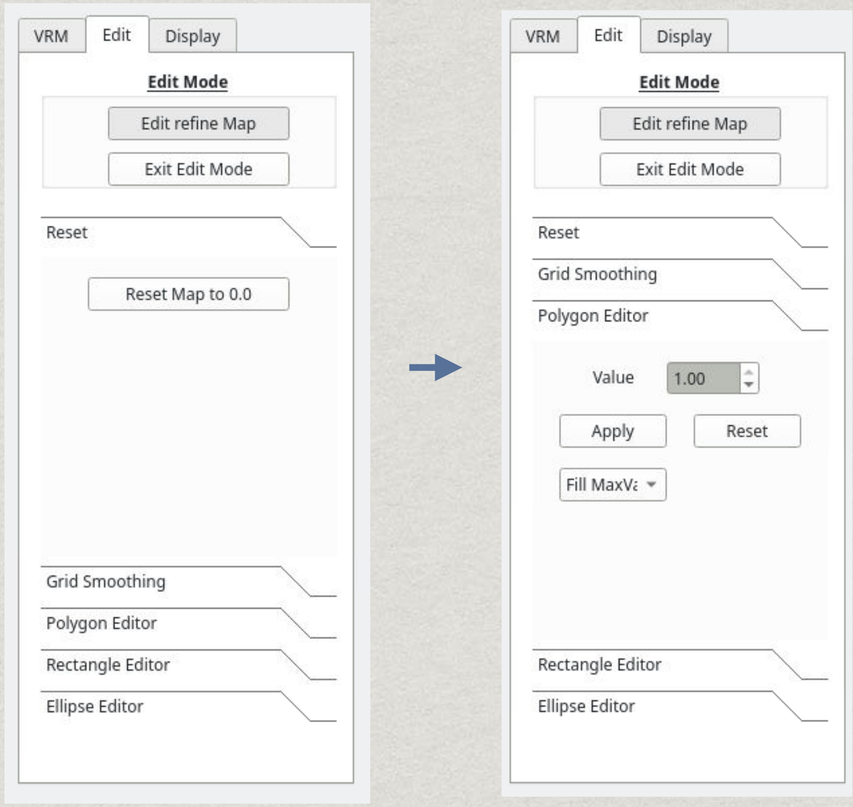


Reoriented Grid



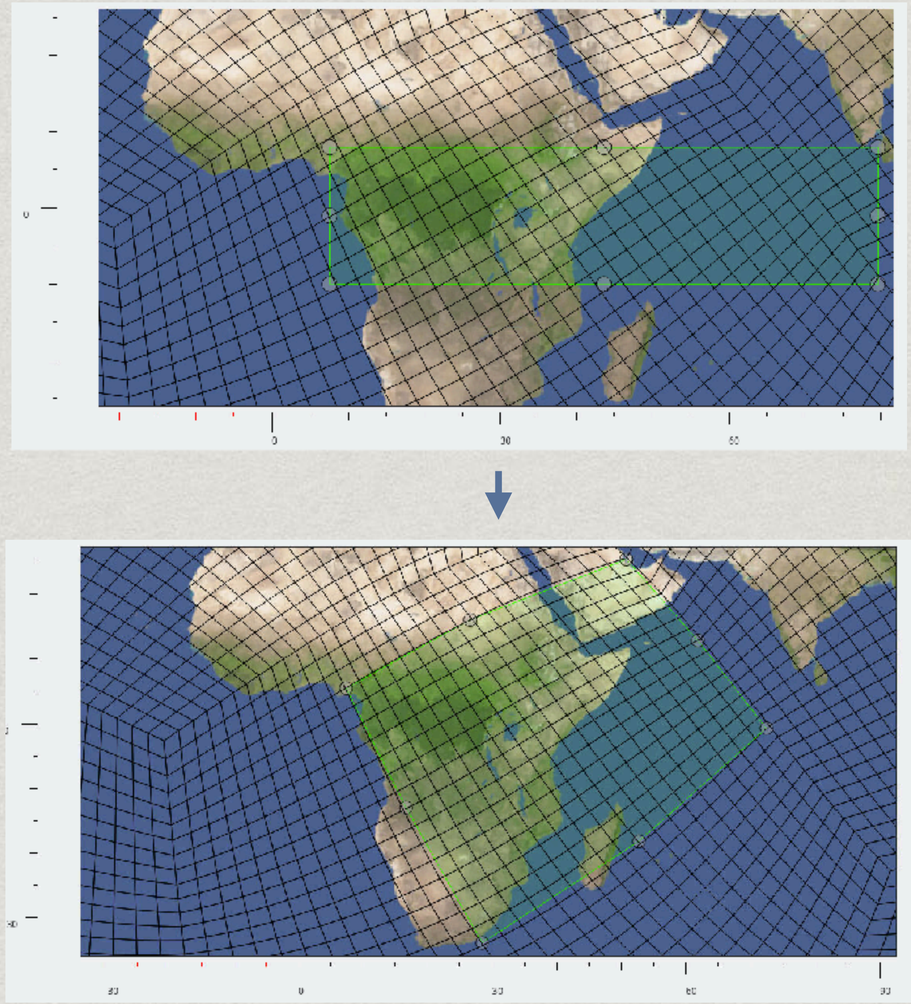
Initial Generation of a Grid

- After modifying the rotations, then add in basic refined areas



Initial Generation of a Grid

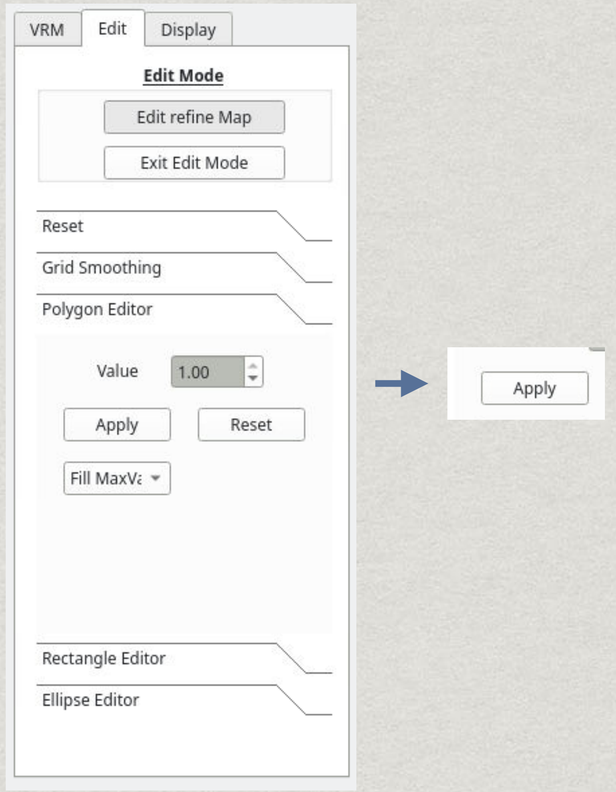
- After modifying the rotations, then add in basic refined areas



Refinement Polygon Editor

Initial Generation of a Grid

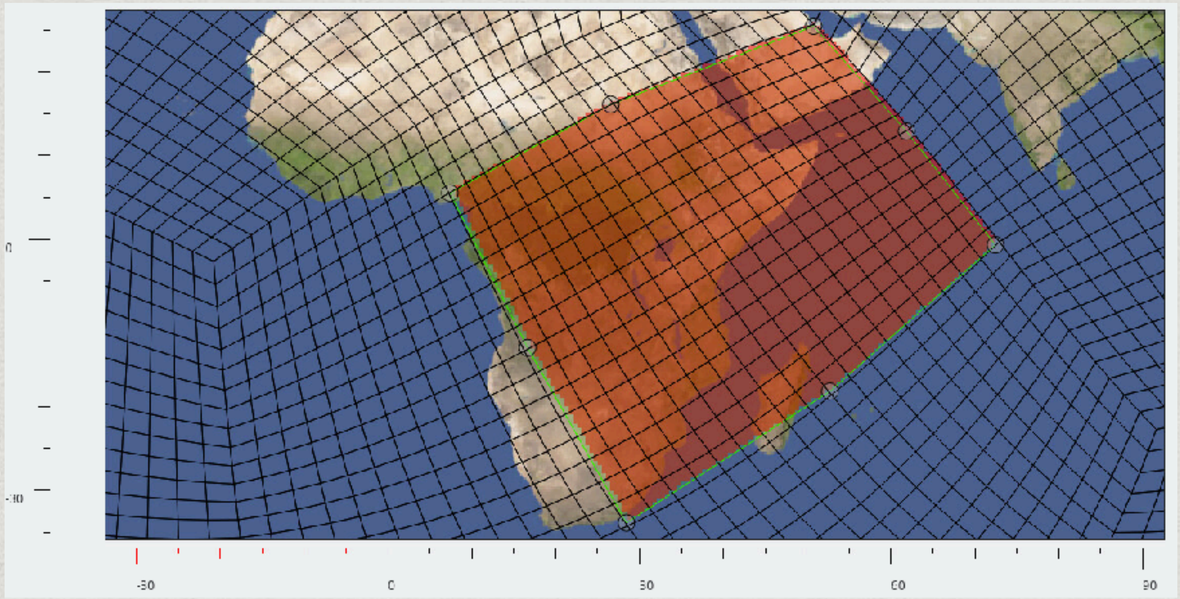
- After modifying the rotations, then add in basic refined areas



Initial Generation of a Grid

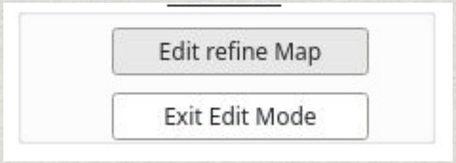
- After modifying the rotations, then add in basic refined areas

Refinement Enacted



Initial Generation of a Grid

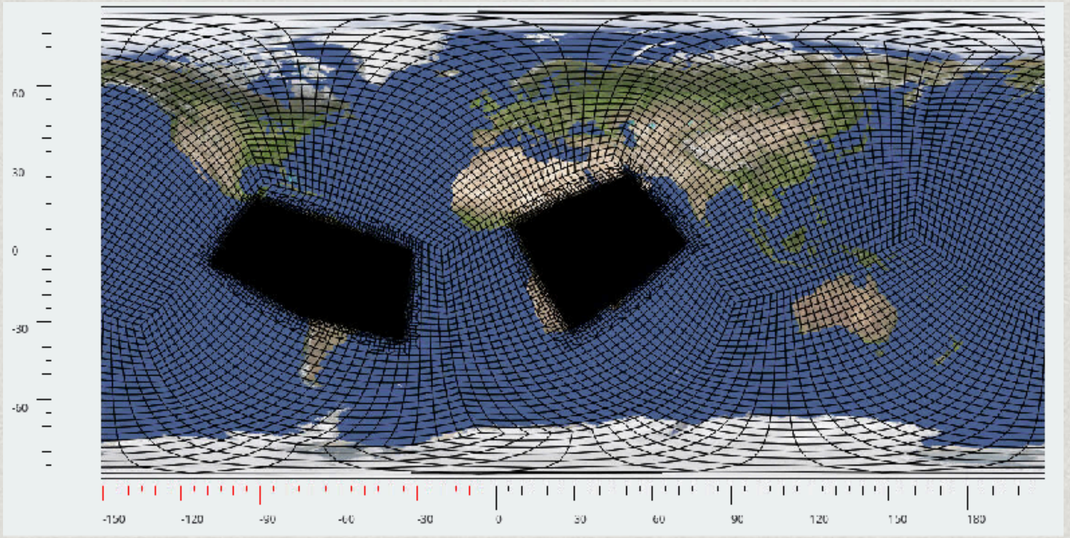
- After modifying the rotations, then add in basic refined areas



Initial Generation of a Grid

- After modifying the rotations, then add in basic refined areas

Example Grids



Phase 2: Clean the Grid

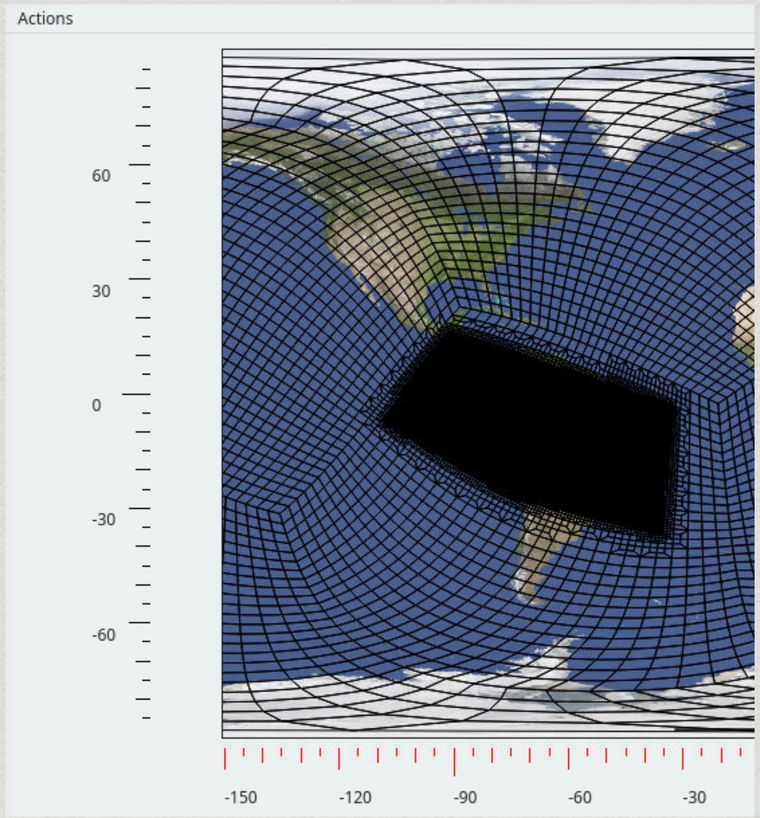
- Export the grid information
  - Exodus File:

    FILENAME_exodus.nc
  - Refinement Grid File:

    FILENAME_refinemap_file.dat
  - Refinement Map File:

    FILENAME_refinemap.nc

Uneven Refinement



Clean the Grid

- The .dat file requires cleaning.
- Followed by compiling the new grid.
- Finally, plotting the grid.

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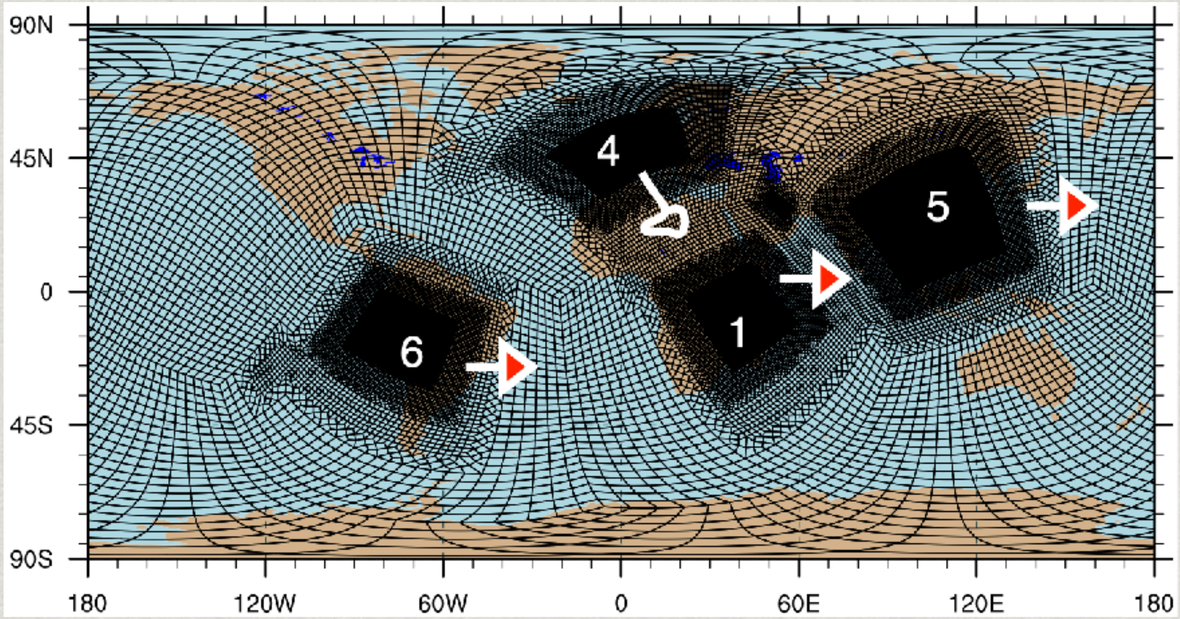
- Finally, plotting the grid.

- This is a relatively tedious and iterative process…

Clean the Grid

- The quickest method, in my opinion, is to download the .dat file to a local machine and using a GUI text editor.
- Make the changes.
- Upload back to where your tools are.
- Then compile and plot.

Grid Orientation



Clean the Grid

- Some helpful tips:
  - 1) Stick to rectangles/squares
  - 2) From the ~1°x1° grid, the .dat file is best to manipulate in groups of 4 digits in the .dat file.
  - 3) The transitions need to be at least 4 grid cells each in the final grid.
    - To accomplish this, each inner transition should be a multiple of 8 digits in the .dat file.
    - The outer transition requires a minimum of 12 digits in the .dat file

Example .dat File

Clean the Grid

- Once the user has stopped using VRM Editor, they cannot go back!
- To regenerate the grid requires using the command line version:
  - Create_VRMgrid.cpp
  - The program must be compiled
  - Edit the Makefile-Create_VRMgrid to make sure the paths to the libraries are correct, then execute

    >make -f Makefile-Create_VRMgrid

Clean the Grid

- The Exodus file contains the grid setup information.
- This is a netcdf file, and the information in that file become the inputs for the command line VRM Editor:

  > ${MASTERDIR}Create_VRMgrid --refine_type ${reftype} --grid_type ${grtype} --smooth_type ${smthtype} --resolution ${resolu} --refine_level ${reflvl} --tessellate ${teslate} --subcells ${subcel} --smooth_dist ${smdist} --smooth_iter ${smiter} --x_rotate ${xaxis} --y_rotate ${yaxis} --lon_shift ${laxis} --refine_file ${ifile} --output ${ofile} --refine_cube ${refcube}

- The result from this is plotted with a NCL script.

Clean the Grid

- I generated a .csh script that will execute both the command line VRM Editor, and then activate the NCL script.

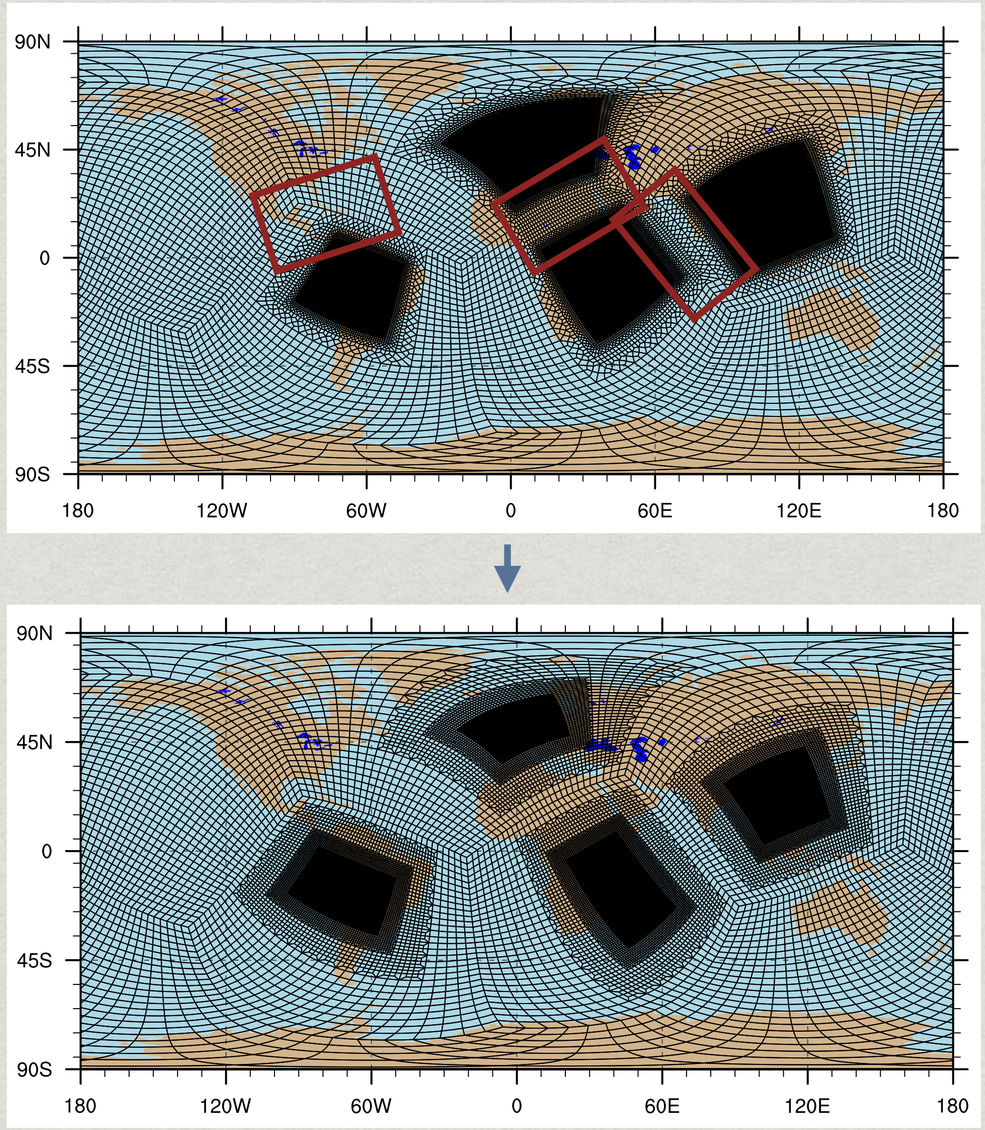
Compile Grid and Plot Executable

```
#!/bin/tcsh -fv
#################


setenv MASTERDIR /glade/u/home/jbuzan/Community_Mesh_Generation_Toolkit-master/VRM_tools/VRM_Editor/src/
setenv DATDIR ${MASTERDIR}Grids_JBUZAN/Grids_MODS/
setenv REFDIR ${MASTERDIR}Grids_JBUZAN/Grids_ORIG/
setenv OUTDIR ${MASTERDIR}Grids_JBUZAN/Grids_NEW/

#setenv reftype LOWCONN
setenv reftype CUBIT
setenv grtype CubeSquared
#setenv smthtype SPRING
setenv smthtype NONE
setenv resolu 30
setenv reflvl 3
setenv teslate 0
setenv subcel 0
setenv smdist 0
setenv smiter 0
setenv revorie
setenv xaxis -58
setenv yaxis -22
setenv laxis 32

setenv MAPFILE ne0np4.x-58.y-22.132_rc3_none0_ne30x_newmesh_v03_04
setenv ofile ${OUTDIR}ne0np4.x-58.y-22.132_rc3_none0_ne30x_newmesh_v03_04.nc
setenv refcube ${DATDIR}ne0np4.x-58.y-22.132_rc3_none0_ne30x_refinemap_file.dat

#setenv MAPFILE ne0np4.x-58.y-22.132_rc3_none0_ne30x_newmesh_v01_small_04
#setenv ofile ${OUTDIR}ne0np4.x-58.y-22.132_rc3_none0_ne30x_newmesh_v01_small_04.nc
#setenv refcube ${DATDIR}ne0np4.x-58.y-22.132_rc3_none0_ne30x_refinemap_file_small.dat


#setenv ifile ${REFDIR}ne0np4.x-58.y-22.132_Z3_rc3_spm0_ne30x_refinemap.nc
setenv ifile ${REFDIR}ne0np4.x-58.y-22.132_rc3_none0_ne30x_refinemap.nc
echo ${ifile}
ls ${ifile}
#setenv ifile ${REFDIR}ne0np4.x-58.y-22.132_Z3_rl3_spm0_ne30x_refinemap.nc
#setenv ofile ${OUTDIR}ne0np4.x-58.y-22.132_Z3_rl3_spm0_ne30x_newmesh_v08.nc
#setenv ofile ${OUTDIR}ne0np4.x-58.y-22.132_Z3_rc3_spm0_ne30x_newmesh_v01.nc
#setenv ofile ${OUTDIR}ne0np4.x-58.y-22.132_rc3_none0_ne30x_newmesh_v01.nc
#setenv refcube ${DATDIR}ne0np4.x-58.y-22.132_Z3_rl3_spm0_ne30x_refinemap_file.dat
#setenv refcube ${DATDIR}ne0np4.x-58.y-22.132_rc3_none0_ne30x_refinemap_file.dat

${MASTERDIR}create_VRMgrid --refine_type ${reftype} --grid_type ${grtype} --smooth_type ${smthtype} --resolution ${resolu} --ref
subcells ${subcel} --smooth_dist ${smdist} --smooth_iter ${smiter} --x_rotate ${xaxis} --y_rotate ${yaxis} --lon_shift ${laxis}
ine_cube ${refcube}

ncl /glade/u/home/jbuzan/Community_Mesh_Generation_Toolkit-master/VRM_tools/VRM_Diagnostics/plotting/gridplot.jrb.Z3.ncl


exit
#################
```

Clean the Grid

- Example iterations
- Note the:
  - “edge crossing”
  - Not enough space between refinement areas
  - Bad corners
  - Not enough space between transitions

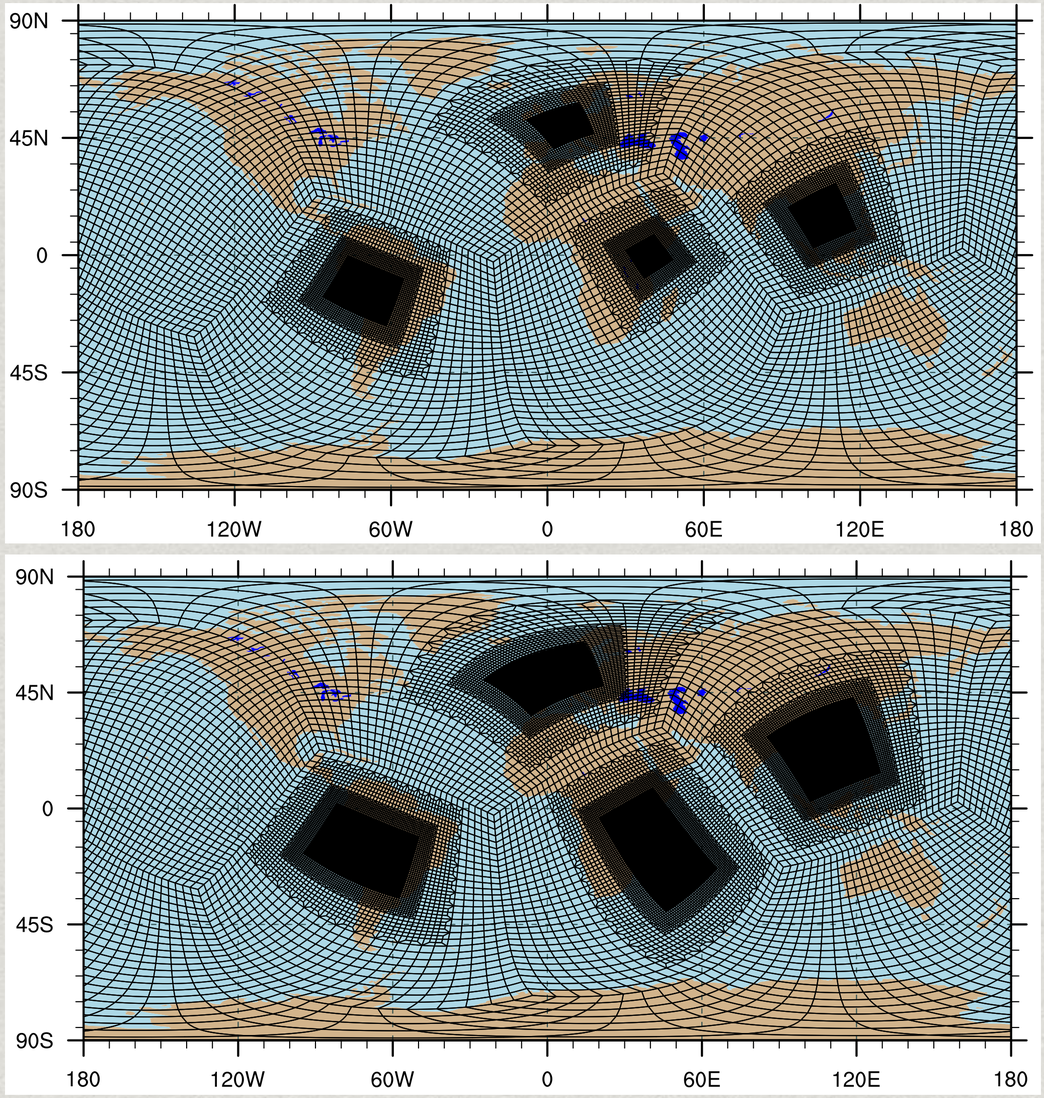
Transitioning to Clean Grid

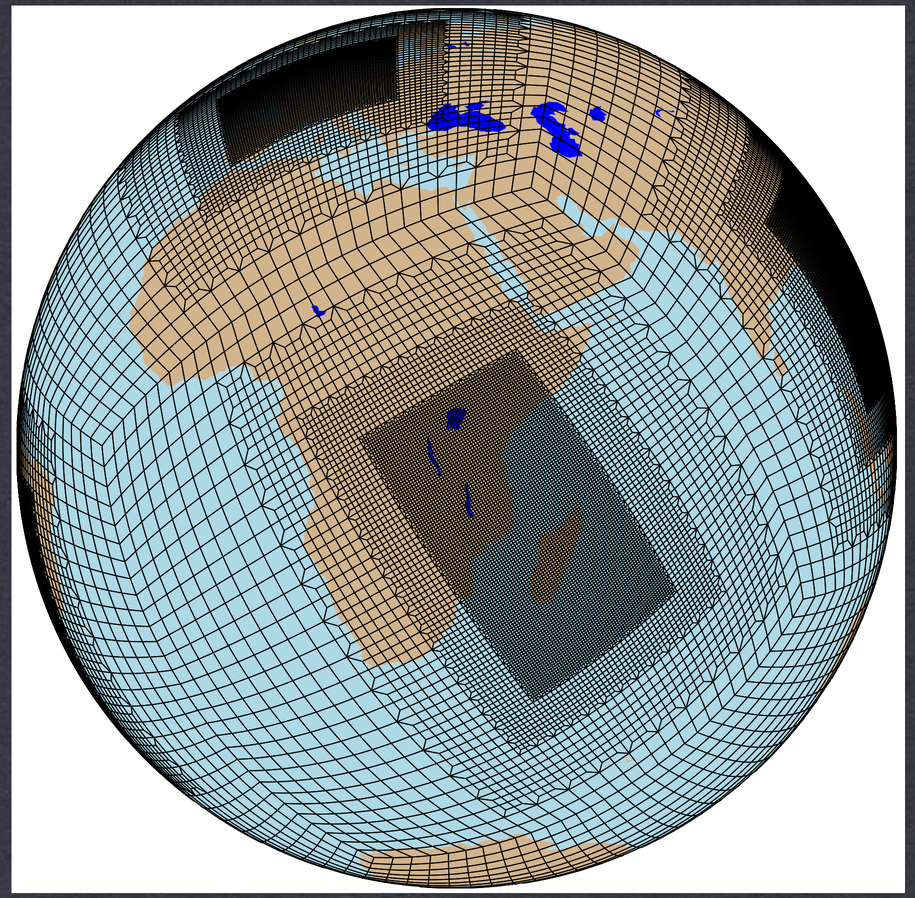


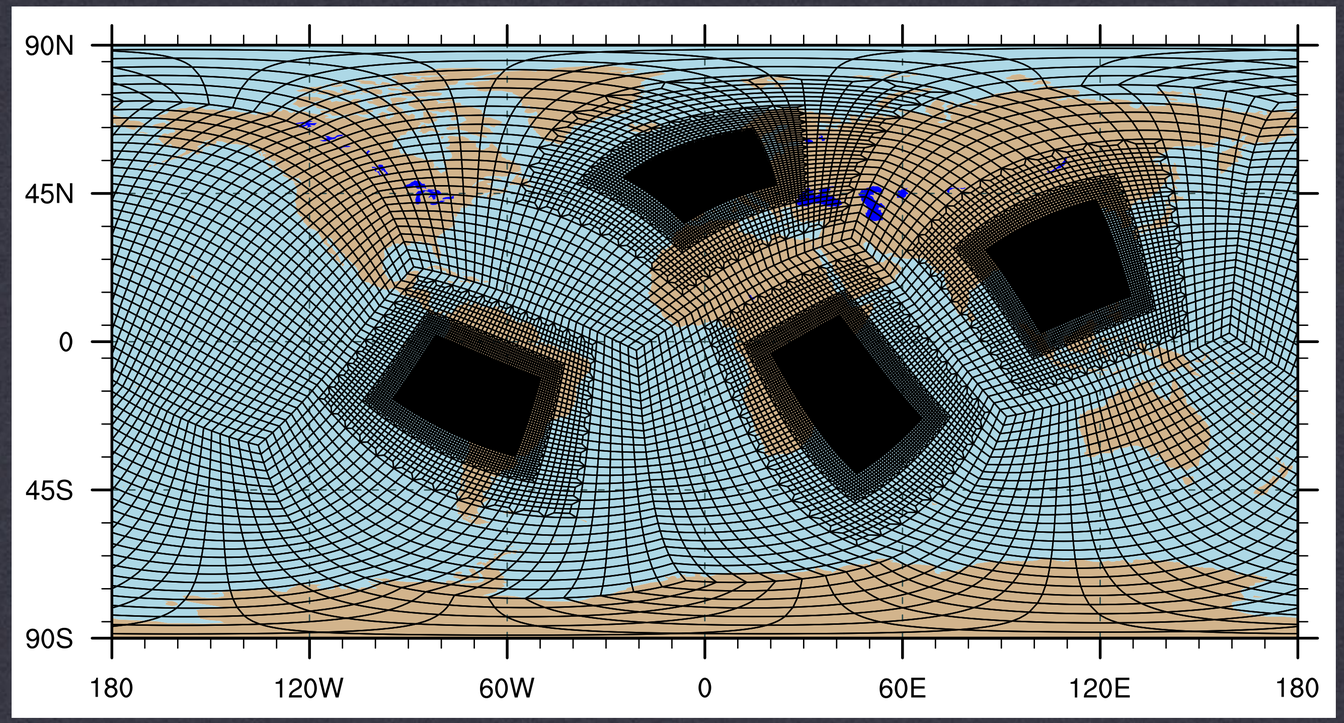
Clean the Grid

- Final solution has clear clean areas.
- Small grid may be too small for proper airmass flow.
- Adam recommends larger grid (or even bigger).

Small and Large Clean Grids







THANK YOU

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